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The Multidimensional Anxiety Scale for Children (MASC): Confirmatory factor analysis in a pediatric ADHD sample

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While considerable attention has been paid to discriminating attention-deficit/hyperactivity and anxiety disorders, there are as yet no published confirmatory factor analytic studies of any self-report anxiety scale in ADHD youth. The Multidimensional Anxiety Scale for Children (MASC) is a 39-item, 4-point Likert self-report scale that robustly represents the factor structure of anxiety in children aged 8 to 18 years. Using confirmatory factor analytic methods, the present paper reports a replication of the four-factor measurement model for the MASC in a large sample of ADHD youth aged 7 to 10 years. The fit indices proved to be comparable to those obtained in the MASC clinical and non-clinical (normative) samples. Clinically, therefore, this report strengthens confidence that the MASC is a valid measure of anxiety in diverse populations. With respect to research, it provides supporting evidence that results obtained using the MASC in the MTA and other research studies reflect valid estimates of anxiety in those samples.

Presumably because pathological anxiety is associated with significant suffering, disruption in normal psychosocial and academic development and family functioning, and increased utilization of medical services, "worry" is among the more common causes of referral to children's mental health care providers (Black, 1995; Simon, Ormel, VonKorff, & Barlow, 1995). Nonetheless, the prevalence of childhood-onset fears in the population, the structure of anxiety symptoms in the general pediatric population, and the relative importance of specific anxiety dimensions within gender, ethnic, cultural, or neuropsychiatric disorder-based groupings has remained unclear, in part because of a lack of acceptable measurement tools (Costello & Angold, 1995; Last, Perrin, Hersen, & Kazdin, 1992).

We recently described the development and preliminary factor structure of the Multidimensional Anxiety Scale for Children (MASC), which rectifies problems found with older instruments (March & Parker, in press; March, Parker, Sullivan, Stallings, & Conners, 1997a). The MASC is a 39-item, 4-point, Likert self-report scale, which has undergone extensive psychometric evaluation (March, 1998). The MASC main and subfactors include the following: (1) physical symptoms (tense/restless and somatic/autonomic), (2) social anxiety (humiliation/rejection and public performance fears), (3) harm avoidance (anxious coping and perfectionism) and (4) separation anxiety. The MASC contains two other empirically-derived subscales: (1) a 10-item unifactorial short form (MASC-10) intended for use in epidemiological and treatment outcome studies, and (2) a 12-item anxiety disorder index with a high degree of diagnostic efficiency (March, 1998). The Internal reliability and test-retest reliability for the MASC total score and all the factors and subfactors are in the satisfactory to excellent range (March et al., 1997a; March, Sullivan, & Parker, in press).

A series of confirmatory factor analyses have been conducted for the four-factor MASC across multiple normal and psychopathological groupings (March, 1998). In the initial study, the

four-factor model for the 39-item MASC met the criteria standards for adequacy of fit (Bentler, 1988) in both school-based population and clinical psychiatric samples March, 1998). Subsequently, separate multi-sample confirmatory factor analyses were conducted to test whether the four-factor MASC was equivalent for males and females and for two age-groups: 12 years old and under and 13 years old and over. Multiple goodness-of-fit indicators revealed that the four-factor model fit well for both age-groups and both genders. Using gender as the exemplar, the non-normed fit index (NNFI, Bentler & Bonnett, 1980) was 0.913, the comparative fit index (CFI, Bentler, 1988) was 0.916, and the incremental fit index (IFI, Bolen, 1989) was 0.917. Similar analyses demonstrated that the MASC factor structure was identical in white and black youth (March, 1998). The overall conclusion to be drawn is that the MASC factor structure is identical across these diverse samples of children and adolescents.

Unlike the RCMAS, which differentiates children with DSM-III-R anxiety and attention-deficit disorders from normals but not from each other (Perrin & Last, 1992), the MASC shows reasonably robust discriminant validity for both ADHD and depression (March, Parker, Sullivan, Stallings, & Conners, 1997b). For example, in a series of analyses using discriminant function analysis, an empirically derived Anxiety Index was used to predict group membership in children and adolescents aged 8 to 18 years with anxiety disorders versus age- and gender-matched normal and ADHD comparison groups. With normals, the overall correct classification rate was an excellent 95 percent. Not surprisingly, discriminating anxiety from ADHD is a much more difficult problem psychometrically than discriminating between subjects with and without clinical symptoms (Perrin & Last, 1992). Nonetheless, the MASC Anxiety Index performs in the satisfactory range. Specifically, in an age- and gender-matched sample, 140 children and adolescents that met DSM-IV criteria for an anxiety disorder other than OCD, or for Attention Deficit/Hyperactivity Disorder (ADHD) sensitivity for the MASC, the Anxiety Index was 75%, the specificity was 67%, the positive predictive power was 73%, the negative predictive power was 69%, the false positive rate was 33%, the false negative rate was 25%, kappa was 0.42, and the overall correct classification rate was 71%. While not quite as robust as the anxiety/normal comparison, the Anxiety Index thus shows a quite acceptable ability to discriminate between children with anxiety and Attention-Deficit/Hyperactivity Disorder.

A limitation of these studies is the lack of *a priori* confirmation that the factor structure of the MASC is identical in anxious and ADHD youth. Surprisingly, despite considerable attention paid to the psychometric problems inherent is discriminating anxiety from ADHD (Conners, March, Erhardt, & Butcher, 1995; March, 1998; March & Albano, 1996), there are as yet no published confirmatory analytic studies of any self-report anxiety scales in ADHD youth. The six-site NIMH collaborative Multimodal Treatment Study of Children with ADHD (MTA) is the largest randomized clinical trial ever undertaken in children by the NIMH (Arnold et al., 1997). The MTA addresses *a priori* questions about the individual and combined effects of pharmacological and psychosocial (behavioral) treatment for children aged 7 to 10 years with ADHD. Among the instruments used in the MTA, the MASC was chosen as the sole self-report instrument for assessing anxiety (Hinshaw et al., 1997). The present paper, using confirmatory factor analytic methods and baseline pre-treatment data from the MTA sample, reports a replication of the four-factor measurement model for the MASC.

Subjects

The rationale and design of the MTA have been reported elsewhere (Arnold et al., 1997; Hinshaw et al., 1997). Briefly, 579 children aged 7 to 9 years and with DSM-IV ADHD (combined type) were selected by using a multiple-gate study entry procedure, after which they

were randomly assigned to one of the following treatments: medication management, a multi-component psychosocial/ behavioral treatment, the combination of medication and psychosocial treatment, or community-control assessment-and-referral. The MTA sample is representative of the broad range of ADHD youth. Eighty-two percent are male; the mean age is 8.2 years; and 69% are Caucasian, with the remainder predominately African/American and Hispanic/Latino. Approximately 20% are on welfare and 30% are from single-parent families. The current report includes pre-treatment baseline data from the entire MTA sample for which the MASC was available (n = 571).

Statistical Methods

Confirmatory factor analysis (CFA) using full maximum likelihood estimates was conducted using SPSS AMOS 3.61 (Arbuckle, 1996). The four MASC factors represent a moderately correlated subset of a unitary anxiety factor CFA (March, 1997; March, 1998), which argues against the need for statistical independence at the factor level in CFA. Hence, based on theoretical considerations, the four main MASC factors were allowed to covary in the final CFA model. Item error terms were allowed to covary within but not across the four MASC factors. Multiple goodness-of-fit indicators were calculated according to Arbuckle (1996). Because each index has different strengths and weaknesses in assessing the goodness-of-fit between a hypothetical model and the actual data, multiple indices are generally thought to be necessary to adequately evaluate model fit to the data (Arbuckle, 1996; Bentler, 1995)

Results

For the four-factor MASC model, the adjusted goodness of fit index (AGFI) was .900, the non-normed fit index (NNFI) was 0.910, the comparative fit index (CFI) was 0.918, the incremental fit index (IFI) was 0.920 and the RMSEA was .031. As suggested by Bentler (1995), values indicating that the model shows excellent fit of the model to the data are AGFI > 0.800, NNFI > .900, CFI > .900, the IFI > .900 and RMSEA < 0.05, indicating that the four-factor MASC model shows excellent fit to the data in the MTA sample. To allow evaluation of the relative importance of each MASC item loading on the four main MASC factors, Table 1 reports standardized regression (beta) weights for each item. Additionally, correlation coefficients for the four MASC factors in this model fell in the expected range: physical*harm avoidance = 0.375, social*separation = 0.832, physical*social = 0.772, harm avoidance*separation = 0.645, social*harm avoidance = 0.540, physical*separation = 0.829.

Conclusion

The overall conclusion gained from this study is that the MASC factor structure replicates satisfactorily in a sample of children with ADHD. Indeed, fit indices in this sample are only slightly less robust than those in clinical and non-clinical samples that are broadly representative of both clinical and normal populations of children and adolescents aged 8 to 18 years. Clinically, therefore, this report strengthens confidence that the MASC is a valid measure of anxiety in diverse populations, including youth with ADHD. With respect to research, it provides supporting evidence that results obtained using the MASC

MASC Item		***Factor***	***Estimate***
m01	<———	phys	0.415
m05	<———	phys	0.447

m08	<———	phys	0.612
m12	<———	phys	0.559
ml5	<———	phys	0.402
m18	<———	phys	0.495
m20	<———	phys	0.616
m24	<———	phys	0.546
m27	<———	phys	0.471
m31	<———	phys	0.438
m35	<———	phys	0.508
m38	<———	phys	0.472
m03	<———	soc	0.500
m10	<———	soc	0.635
m14	<———	soc	0.580
m16	<———	soc	0.609
m22	<———	soc	0.661
m29	<———	soc	0.523
m33	<———	soc	0.522
m37	<———	soc	0.539
m39	<———	soc	0.449
m02	<———	HA	0.343
m06	<———	HA	0.456
m09	<———	HA	0.345
m13	<———	HA	0.602
m21	<———	HA	0.367
m25	<———	HA	0.529
m28	<———	HA	0.302
m32	<———	HA	0.583
m36	<———	HA	0.501
m04	<———	sep	0.519
m07	<———	sep	0.477
m11	<———	sep	0.387
m17	<———	sep	0.329
m19	<———	sep	0.385
m23	<———	sep	0.308
m26	<———	sep	0.355
m30	<———	sep	0.444
m34	<———	sep	0.526

Table 1 Standardized regression weights

in the MTA and other research studies reflect true estimates of anxiety in those samples. In addition, replicating the factor structure across ADHD youth buttresses previous work demonstrating satisfactory discriminant validity for the MASC relative to normal and ADHD youth.

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